Short-term algal testing – a new approach for disclosing silver nanoparticle toxicity

Sørensen, Sara Nørgaard; Laurelle, Sacha; Baun, Anders; Engelbrekt, Christian

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WE047 Short-term algal testing – a new approach for disclosing silver nanoparticle toxicity S.N. Sorensen, DTU Environment / Environmental Engineering; S. Laurelle, A. Baun, C. Engelbrekt, Technical University of Denmark. Silver is the most common nanomaterial in commercial products, mainly used for its antimicrobial properties. Increasing use of silver nanoparticles (AgNPs) is expected to cause release into the environment. Several studies explain the toxicity of AgNPs to aquatic organisms by released ionic silver, while other studies cannot relate all of the observed toxicity to this fraction.**Overall,** still little is known about AgNP toxicity and the underlying mechanisms. The aim of this study was: 1) to determine whether AgNPs display ionic behaviour as measured by algal toxicity under various conditions and 2) to investigate the effect of a shortened exposure period on AgNP and $AgNO_3$ toxicity. A series of tests were conducted with citrate capped silver nanoparticles (AgNP-Citrate), reference OECD silver nanoparticles (NM-300K) and silver nitrate as a reference for dissolved silver. The algae *Pseudokirchneriella subcapitata* were used as a test organism in both a standard growth inhibition test (ISO 8692:2004) for 48h and a short-term (2h) test, using ^{14}C-incorporation during photosynthesis as toxic endpoint. Characterization of AgNPs included ICP-OES, DLS, NTA, and TEM. For all three test materials, the two methods were carried out under conditions of pH 7 and 8, and with added cysteine as ionic silver ligand. For $AgNO_3$, similar EC_{50} values were obtained in the 2h and 48h tests, showing a fast mechanism for algal toxicity of dissolved silver. In all tests, $AgNO_3$ was significantly more toxic than NM-300K, which again was more toxic than AgNP-citrate. For the nanoparticles, 2h exposure at pH 8 resulted in higher toxicity than after 48h for NM-300K, while AgNP-citrate was less toxic in the 2h test. This difference may be related to the different endpoints of the two tests, as well as the size and composition of the nanoparticles. The toxicity of the three test materials all decreased from pH 8 to 7 in the 48h tests, and similarly for $AgNO_3$ in the 2h tests. As expected, the toxicity was further reduced by the addition of cysteine. Overall, the observed changes in toxicity arising from varied exposure conditions correspond well with the anticipated outcome for ionic compounds. The 2h algal test setup provides a measure for photosynthesis inhibition and allows for high throughput screening of nanoparticle toxicity while minimizing potential confounding factors experienced in standard algal tests due to e.g. media composition and test duration.